United States
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REASONABLY FORESEEABLE DEVELOPMENT SCENARIO FOR OIL AND GAS IN THE SAN RAFAEL DESERT MASTER LEASING PLAN AREA

PRICE AND RICHFIELD FIELD OFFICES

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Bureau of Land Management
Price Field Office
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Price, Utah

REASONABLY FORESEEABLE DEVELOPMENT (RFD) SCENARIO
FOR OIL AND GAS IN THE SAN RAFAEL DESERT MASTER LEASING PLAN AREA,

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Cover - Photograph of Vibroseis Buggies on Dawson's San Rafael Saddle 3-D Geophysical Project, T. 26 S., R. 14 E., Emery County, Utah. Photo was taken by Don Stephens on February 12, 2008.

REASONABLY FORESEEABLE DEVELOPMENT (RFD) SCENARIO FOR OIL AND GAS IN THE SAN RAFAEL DESERT MASTER LEASING PLAN AREA

I. Summary

A Reasonably Foreseeable Development (RFD) Scenario for oil and gas is a long-term projection of oil and gas activity. The following RFD Scenario projects the level of oil and gas activity that can reasonably be expected to occur in the San Rafael Desert Master Leasing Plan Area (SRD MLPA) during the next 15 years. This RFD document is intended to project a baseline scenario of oil and gas exploration, development, production, and reclamation activity to aid the Bureau of Land Management (BLM) with land use planning by providing a mechanism to analyze the effects that discretionary management decisions may have on oil and gas development, local and regional economies and important resource values such as air quality, cultural resources and wildlife habitat.

The SRD MLPA encompasses a total of 428,724 acres in Emery County, Utah and 96,125 acres in Wayne County, Utah, a total of 524,849 acres, 450,807 acres of which are public lands administered by the BLM. The majority of lands within the SRD MLPA (86 percent) are public lands administered by the BLM. State lands encompass 12 percent of the SRD MLPA and private lands make up 2 percent within the SRD MLP. Public lands in Emery County are managed by the Price Field Office, and public lands in Wayne County are managed by the Richfield Field Office.

The following RFD projections are based largely on local geology, current and historical trends in oil and gas activity, and forecasts of crude oil and natural gas markets. The SRD MLPA currently has no production of oil and gas. The SRD MLPA is wholly or partially within two oil and gas "Plays" as defined by the U.S. Geological Survey (USGS, 1995). The Fractured Interbed Play (Play 2103) is associated with the commercial production of oil and gas within the Moab Field Office. In addition, the Buried Fault Block Play (Play 2101) is found within the Moab Field Office and is an oil & gas producing play which could extend into the SRD MLPA. The Salt Anticline Flank Play (Play 2105) does not have production in the Moab Master Leasing Plan Area. The presence of oil & gas producing plays in the Moab Field Office gives development potential to the SRD MLPA which is adjacent to areas in the Moab Field Office which currently have commercial production of oil and gas.

The U.S. Energy Information Administration (EIA) projects the price of oil to escalate gradually and continuously through the year 2040 (final year of projection) at which time a barrel of crude oil would be $141 in 2013 dollars. Natural gas prices are presently very low, both in terms of historical trend and relative to oil on a Btu (energy equivalency) basis. The EIA projects gas prices will escalate to a final projected price of $7.85 / mcf (corrected to 2013 dollars) in the year 2040. For the purpose of projecting oil and gas drilling activity in the SRD MLPA, it is assumed that the demand and price for crude oil will improve from current low demand and the natural gas market will generally improve during the next 15 years.

There have been a total of 79 wells drilled in the SRD MLPA, with five wells drilled since 1985. The last well drilled in the SRD MLPA was in 1989. All of the wells drilled within the SRD MLPA have been plugged and abandoned. The potential for drilling success in the SRD MLPA for the future would be enhanced by advances in horizontal drilling, completion, and geophysical technology that have been made in the last 20 years. The trend in drilling and drilling success rates within the Moab Field Office in the Fractured Interbed Play (Play 2103), combined with forecasted improving market conditions, favor the potential for discovery of economic quantities of oil & gas within the SRD MLPA.

Future oil and gas drilling for the next 15 years is projected to average two wells per year for a total of 30 wells. This would result in a total surface disturbance of 585 acres from construction of new well pads and associated infrastructure, including roads and pipelines. The estimated total existing surface disturbance from previous oil and gas activity in the SRD MLPA is 0 acres due to the fact that the last well drilled in the area was plugged and abandoned over 25 years ago. Over the next 15 years a total of 585 acres will be disturbed by oil and gas drilling activity and of that total 492 acres will be reclaimed or under reclamation giving a net surface disturbance of 93 acres.

For geophysical exploration, 270 linear miles of source lines with an associated surface disturbance of 330 acres are projected over the next 15 years. Total geophysical related surface disturbance that will be reclaimed during the next 15 years will be 264 acres, leaving a net surface disturbance of 66 acres.

The baseline RFD scenario for the SRD MLPA is summarized as follows:

- The average area of surface disturbance for each new well projected to be drilled during the next 15 years (including well pads, roads, gathering pipelines, and projected main pipeline will be 19.5 acres.
- Future oil and gas drilling for the next 15 years is projected to average two wells per year for a total of 30 wells. Twelve of the wells are projected to be dry holes.
- Future surface disturbance for 30 projected new wells and associated infrastructure will be approximately 585 acres.
- A total of 492 acres of surface disturbance will be reclaimed during the next 15 years; including 12 dry holes, and interim reclamation of 18 future producing wells.
- The total net surface disturbance for all drilling activity in the SRD MLPA over the next 15 years will equal roughly 93 acres.
- Future surface disturbance over the next 15 years for geophysical exploration (270 linear miles of source lines) will be approximately 330 acres.
- Total geophysical related surface disturbance to be successfully reclaimed during the next 15 years will be 264 acres.
- The total net surface disturbance for geophysical activity in the SRD MLPA over the next 15 years will be roughly 66 acres.

These baseline projections represent average activity levels over the next 15 years and are not intended to be thresholds for limiting future activity. Oil and gas exploration and development activity tends to be sporadic over time due to market influences and other factors affecting the oil and gas industry. Because of this, it is recognized that during the next 15 years there may be years when oil and gas activity in the SRD MLPA would be much less than the projected average levels and other years when activity may be greater.

II. Introduction

In 2002, the BLM Price Field Office released a Mineral Potential Report (PMPR) assessing oil and gas within its planning area. In 2005, the BLM, Richfield Field Office released a Mineral Potential Report (RMPR) assessing oil and gas within its planning area. The Reasonably Foreseeable Development (RFD) scenarios released in 2008 for the Price and Richfield RMPs projected oil and gas activity for the entire planning areas in each field office (totaling approximately 2,500,000 million acres of surface estate for the Price Field Office and 2,100,000 acres for the Richfield Field Office). In 2008, Resource Management Plans (RMP) and Final Environmental Impact Statements, which included detailed RFD scenarios for oil and gas for the Price and Richfield Field Offices, were approved.

The BLM is now preparing the San Rafael Desert Master Leasing Plan (SRD MLP) to consider oil and gas leasing on approximately 450,807 acres of public lands within the Price and Richfield Field Offices (Map 1) in accordance with BLM Washington Office Instruction Memorandum No. 2010-117. The following RFD Scenario projects the level of oil and gas activity that can reasonably be expected to occur in the SRD MLPA during the next 15 years. In preparing this RFD scenario for the SRD MLPA, the BLM relied on the 2002 and 2005 MPR and 2008 RFD documents for information about the area's geology and its mineral occurrence and development potential. The conclusion of oil and gas occurrence is unchanged since 2008 but the development potential is greater within the SRD MLPA area due to the success of horizontal drilling in the Cane Creek shale in the Paradox Formation in adjacent areas of the Moab Field Office. The following RFD projections take into account updated information about current and historical oil and gas activities specific to the SRD MLPA and in the adjacent Moab Field Office, including; leasing, geophysical exploration, exploration drilling, production, and reclamation. Projections of future oil and gas activity in the SRD MLPA also take into consideration current and forecasted trends in the crude oil and natural gas markets.

The SRD MLP may require amendments to the Price and Richfield RMPs if new leasing stipulations and development constraints are proposed. As part of the planning process, the BLM will prepare an Environmental Assessment (EA) to comply with the requirements of the National Environmental Policy Act (NEPA). This RFD is neither a planning decision nor the "No Action Alternative" in the NEPA document. The RFD is a technical report intended to project a baseline scenario of oil and gas exploration, development, production, and reclamation activity to aid the BLM with land use planning by providing a mechanism to analyze the effects that discretionary management decisions may have on oil and gas development, local and regional economies and important resource values, such as, air quality, cultural resources, and wildlife habitat.

Pursuant to Instruction Memorandum No. 2004-089, an RFD projection assumes that all potentially productive oil and gas areas are open for leasing under standard lease terms and conditions except those areas designated as closed to leasing by law, regulation or executive order. Since there are no lands within the SRD MLPA that are closed to leasing by such authority, the following RFD baseline projection assumes that all lands in the SRD MLPA are available for leasing with standard lease terms. The SRD MLPA includes Federal, private and State lands. Lands within the SRD MLPA total approximately 524,849 acres, of which, approximately 450,807 acres are public lands administered by the BLM. The SRD MLPA does not include lands where federally owned minerals underlie surface acreage that is not administered by the BLM (split estate). Table 1 shows the land ownership status and acreage breakdown of all lands within the SRD MLPA.

Table 1. Status of lands in the SRD MLPA

Land status	Price FO	Richfield FO	SRD MLPA Total
	acres	acres	acres
BLM	365,307	85,500	450,807
State	51,216	10,625	61,841
State Parks	0	0	0
Private	12,201	0	12,201
Split Estate*	0	0	0
Total	**428,724**	**96,125**	**524,849**

Source: BLM Green River District 2016

- Split Estate Surface rights privately owned and the subsurface mineral rights federally owned.

III. Description of Geology

The geology of the SRD MLPA is described in detail in the Mineral Potential Reports for the Price and Richfield RMPs (BLM, 2002; BLM, 2005). Hintze in the Geologic History of Utah (Hintze, 1988) produced geologic sections in the general area, Chart 67 and Chart 83, and are in included in Appendix-B. The eastern three quarters of the SRD MLPA is within the Paradox Basin Geological Area. As part of its 1995 National Assessment of United States Oil and Gas Resources, the U.S. Geological Survey (USGS, 1995) delineated oil and gas "Plays" in the Paradox Basin (BLM, 2012). The SRD MLPA is wholly or partially within two of the oil and gas plays defined by the USGS. In March 2012, the USGS published the results of a more recent assessment of the Total Petroleum Systems (TPS) of the Paradox Basin that was based on the Total Petroleum System (TPS) rather than the plays concept (USGS, 2012). However, to maintain consistency with the Price and Richfield RMPs in describing oil and gas resources in the Price and Richfield Field Offices, the 1995 data are used. Map 2 shows the aerial extent of each oil and gas play delineated within the SRD MLPA. In addition there is a third play (2101) delineated within the MMLPA that could extend into the SRD MLPA. These three plays are:

Play 2103 Fractured Interbed Play (Unconventional Continuous Type Play)
Play 2105 Salt Anticline Flank Play (Conventional Structural Type Play)
Play 2101 Buried Fault Blocks Older Paleozoic Rocks (Conventional Structural Play)

Play 2103 (Fractured Interbed play) underlies the eastern three quarters of the SRD MLPA (BLM, 2002 and BLM, 2005) in the Paradox Basin geological area. This play is an unconventional continuous-type play that depends on extensive fracturing in the organic-rich dolomitic shale and mudstone in the interbeds between evaporites of the Paradox Formation or carbonate and clastic rocks of the related cycles on the shelf of the Paradox evaporite basin. Jointing and fracturing of the interbeds in the Paradox Fold and Fault Belt are controlled by regional tectonics and more localized salt movement, dissolution and collapse (Chidsey, 2004). This play is thought to be self-sourced from the same organic-rich black dolomitic shales and mudstones of the Paradox Formation (BLM, 2012). The Cane Creek Shale discoveries within the Moab Master Leasing Plan Area (MMLPA) are found in this play. There are no oil and gas fields in this play within the SRD MLPA; however, there are oil and gas fields in the Moab Field Office part of the play, including the Big Flat, Long Canyon, Park Road, Hell Roaring, Cane Creek, Threemile, LaSal, and Golden Eagle fields and in addition the Greentown Prospect. In addition to the Cane Creek Shale, there are other organic shales in the play, notably the Chimney Rock, Gothic, and

Hovenweep Shales, which may provide additional drilling targets for hydrocarbon accumulations (USGS, 2012).

Play 2105 (Salt Anticline Flank play) is a conventional-type structural play and is found underlying the eastern one-third of the SRD MLPA (BLM, 2002 and BLM, 2005) that is in the Price Field Office, but does not extend into the Wayne County portion of the SRD MLPA (Map 2). This play is characterized by oil and gas productive Permian and Pennsylvanian reservoirs along the flanks of northwest-trending salt anticlines in the axial part of the Paradox Basin. Source rocks are thought to be organic-rich black dolomitic shales of the Hermosa Group, as well as coaly carbonaceous shale locally present at the Cutler-Hermosa contact (BLM, 2012). Extensive fracturing along the anticlines can also provide conduits from source rocks to reservoirs. There is no production from reservoirs in this play within the MMLPA. The largest accumulations in this play include the South Pine Ridge and Big Indian South fields in Utah and the Andy's Mesa and Hamilton Creek fields in the Paradox Fold and Fault Belt province of western Colorado.

Play 2101 (Buried Fault Block Play) is a conventional-type structural play and was not shown in the Price 2002 Mineral Potential Report or in the Richfield 2005 Mineral Potential Report as being present in the SRD MLP area but is present in the entire MMLPA except a small area in the southwest part. This play includes oil and gas trapped in porous dolomite or dolomitic limestone beds of the Upper Devonian McCracken Sandstone Member of the Elbert Formation and the Mississippian Leadville Limestone (USGS, 1995). The seals for these traps are the Pennsylvanian Paradox Formation evaporates that overlie the carbonate reservoirs or are in fault communication with them. Probable source rocks are the organic-rich black dolomitic shales of the Pennsylvanian Paradox Formation. Within the MMLPA, accumulations of oil and gas in this play include the Salt Wash, Big Flat, and Hatch Point fields. The largest accumulation of oil and gas in this play (Lisbon field) is located approximately 6 miles east of the MMLPA. With over 50 million barrels of cumulative oil production, the Lisbon field is one of the largest producing fields in Utah.

IV. Past and Present Oil and Gas Exploration

Geophysical Exploration

Geophysical exploration has occurred in all portions of the SRD MLPA in the past. Both 2-D and 3-D seismic projects have taken place within the SRD MLPA. The Utah Division of Oil, Gas and Mining has a database which contains information on seismic surveys conducted within the state of Utah. Map 4 shows the locations of these surveys within the SRD MLPA; however, this is not an exhaustive list (UDOGM, 2016).

V. Past and Present Oil and Gas Development Activity

Oil and Gas Leasing Activity

Authorized and pending Federal oil and gas leases within the SRD MLPA cover a total of 82,454 acres. This is approximately 16 percent of the SRD MLPA. In addition there have been 97,452 acres of land nominated for leasing, but deferred since 2011 because the SRD MLPA was going to be prepared. The Utah State Director has deferred all lands within proposed MLPs from leasing until the MLPs are completed. Federal oil and gas leases and deferred lands are shown on Map 5.

Historical Drilling Activity

There have been 79 wells drilled (Table 2) in the SRD MLPA, all of which have been plugged and abandoned (Map 5).

There have been a total of five wells drilled in the SRD MLPA during the past 31 years (UDOGM, 2016). Of the five wells drilled, three were drilled on Federal lands and two were drilled on State lands.

Table 2. Wells Drilled in the SRDMLPA

WELL_NAME	QTR_QTR	SECTION	TOWNSHIP	RANGE	COUNTY	LEASE_NUM	ABNDON DATE
AMAX-SINCLAIR GOVT 29-4B	NWNW	29	220S	150E	EMERY	UTU-036250	12/3/1961
GREEN RIVER DESERT U 9-7	SWNE	09	220S	150E	EMERY	UTU-08861	1/5/1964
45-56	NESW	05	240S	150E	EMERY	UTU-02410	4/8/1951
LOOKOUT POINT UNIT 1	SESW	29	250S	160E	EMERY	UTU-08867	10/25/1957
MOONSHINE WASH U 1	NESW	32	250S	150E	EMERY	ML-5030	10/18/1956
MOONSHINE WASH U 2	SWNE	22	250S	150E	EMERY	UTU-08741	7/4/1958
FOREST GOVT 1	NENE	11	230S	140E	EMERY	UTU-010356A	6/22/1963
DUGOUT CREEK U 1	NESE	21	240S	140E	EMERY	UTU-08196A	1/8/1959
NEQUOIA ARCH U 3	SESE	26	260S	140E	EMERY	UTU-08699	7/2/1960
NEQUOIA ARCH U 7	SWSW	30	260S	140E	EMERY	UTU-05546	12/28/1961
1 MID TOP	SESW	17	260S	130E	EMERY	UTSL-08712A	9/6/1962
HATT 1	SESE	19	230S	140E	EMERY	UTU-09466A	7/15/1958
JAKEY'S RIDGE 12-3	SWNW	03	230S	160E	EMERY	UTU-08970	8/16/1961
JAKEY'S RIDGE 34-15	SWSE	15	230S	160E	EMERY	UTU-015637	10/7/1961
FEDERAL 1	NWNW	07	260S	140E	EMERY	UTU-011206	11/6/1959
NEQUOIA ARCH UNIT 9	NWSW	25	260S	130E	EMERY	UTU-05417	7/16/1962
NEQUOIA ARCH UNIT 10	SWNE	35	260S	130E	EMERY	UTU-03245	2/23/1963
USA-C M BROWN 1	NWNW	24	250S	120E	EMERY	UTSL-169347	1/9/1959
CHAFFIN UNIT 1	NENW	21	230S	150E	EMERY	UTU-14680A	9/2/1959
GRUVERS MESA 1	SENW	19	240S	160E	EMERY	UTU-014152	11/27/1958
GRUVERS MESA 2	NENW	10	250S	160E	EMERY	UTU-032777	3/10/1959
GREEN RIVER UNIT 1	NENW	33	210S	160E	EMERY	UTU-03885	3/22/1965
BOW KNOT UNIT 14-5	SWSW	05	260S	170E	EMERY	UTU-014242	7/19/1962
GRAND FAULT UNIT 14-24	SWSW	24	210S	150E	EMERY	UTU-011978	5/19/1961
N SPRING WASH 31-15	NWNE	15	250S	150E	EMERY	UTU-08782A	8/11/1963
FEDERAL 1	NESW	26	220S	150E	EMERY	UTU-014710	12/16/1957
TEMPLE SPRINGS UNIT 1	NWNW	14	250S	130E	EMERY	UTU-013076	1/28/1960
TEMPLE SPRINGS UNIT 2	SESW	22	250S	140E	EMERY	UTU-031216	2/22/1961
1	SWNW	21	220S	160E	EMERY	FEE	9/20/1943
FEDERAL 1	SWNE	15	240S	160E	EMERY	UTU-0140899	1/30/1967
TEMPLE WASH STATE 1	NWNW	32	240S	130E	EMERY	ML-7140	5/6/1967
TEMPLE WASH GOVT 019-1	SWSE	01	250S	120E	EMERY	UTU-0145019	4/25/1967
TEMPLE WASH GOVT 998-A-1	NWNW	11	250S	130E	EMERY	UTU-074998A	6/14/1967
Calif. Utah Oil Company 1	SESE	05	220S	150E	EMERY	UTSL-028804	?
FEDERAL 1	SENW	28	220S	150E	EMERY	UTU-02181	1/23/1952
MOORE 1	SENW	06	240S	150E	EMERY	FEE	10/10/1954
RUSSELL 1	SWSW	34	250S	120E	EMERY	UTSL-068506	6/7/1953
Demoine Oil Company 1	SESW	19	260S	130E	EMERY	UTSL-033058	?
1	NENE	32	260S	130E	EMERY	STATE	10/1/1946
1	NESW	32	260S	130E	EMERY	STATE	4/8/1947
Pemoore Oil Comapany 1	C	29	260S	140E	EMERY	FEE	?
FEDERAL 1	SENW	21	250S	140E	EMERY	UTU-7337A	12/11/1969
USA FED 1	SWSW	31	260S	160E	EMERY	UTU-15304	3/25/1972
FEDERAL ARMSTRONG 1	NENE	10	240S	140E	EMERY	UTU-0147476	10/9/1972
FEDERAL 11-24-13 (WSW)	SENE	11	240S	130E	EMERY	UTU-0141568	1/29/1974
JESSIES TWIST FED 1-9	SESE	09	230S	140E	EMERY	UTU-15383	8/22/1978
PARADOX 1-12	NENW	12	250S	130E	EMERY	UTU-22103	9/28/1979
PARADOX 1-23	SESW	23	240S	130E	EMERY	UTU-31428	9/26/1979
GEYSER DOME 1-14	NESW	14	220S	150E	EMERY	UTU-18648	3/22/1982
SALERATUS FED ST 2-36	NWNW	36	210S	140E	EMERY	ML-28293	12/24/1981
HARVEY FED 1-21	SENW	21	260S	160E	EMERY	UTU-17554	5/9/1983
GRUVER FED 1-22	NENW	22	240S	160E	EMERY	UTU-38520	7/24/1982
POOL UNIT 1	SWSW	17	260S	170E	EMERY	UTU-18645	1/2/1983
LITTLE FLAT TOP UNIT 1-25	NESE	25	250S	140E	EMERY	UTU-49948	11/8/1983
WILDCAT BUTTE UNIT 1-2	NESE	02	260S	130E	EMERY	ML-29405	11/8/1983
N SPRING CREEK FED 1	NWNE	21	260S	150E	EMERY	UTU-48339	1/25/1985
USA 1-26HR	SWNW	26	220S	140E	EMERY	UTU-53597	12/5/1985
FEDERAL 1-29MW	NENW	29	240S	150E	EMERY	UTU-53611	1/27/1990
NEQUOIA STATE 16-1	SESE	16	260S	140E	EMERY	ML-40577	6/17/1992
CITIES 7 STRAT	NWNW	18	250S	140E	EMERY		3/17/1963
CITIES 8 STRAT	LOT7	01	250S	130E	EMERY		2/23/1963
STATE 36-11	NENE	36	220S	150E	EMERY	ML-50652	4/17/2008
NEQUOIA ARCH U 5	SWSW	17	270S	140E	WAYNE	U-07044-A	11/18/1959
MURPHY-GOVT 1	SESE	13	270S	140E	WAYNE	U-08665	3/24/1962
S HANKSVILLE ST 1	SESW	36	270S	130E	WAYNE	U-08771	1/30/1959
GOVT MANDEL 1	NWSE	31	270S	140E	WAYNE	U-0107781A	1/27/1965
BLACKBURN DRAW U 1	NENE	09	270S	120E	WAYNE	U-08648	2/11/1959
NEQUOIA ARCH U 1	NWNW	05	270S	140E	WAYNE	U-05448-A	3/9/1956
HANKSVILLE UNIT 31-30	NWNE	30	270S	130E	WAYNE	U-09308	6/4/1962
NEQUOIA ARCH UNIT 6	SENE	32	270S	150E	WAYNE		12/24/1960
FEDERAL 1	C-NW	05	270S	140E	WAYNE	U-032263	7/3/1928
FEDERAL 1	SWSW	04	270S	120E	WAYNE	SL-043820	7/1/1913
FEDERAL 1-25	SESE	25	270S	140E	WAYNE	U-0107718	7/29/1973
FEDERAL 1-3	NESW	03	270S	150E	WAYNE	U-0111534	5/29/1973
PARADOX 1-9	SWNE	09	270S	120E	WAYNE	U-31425	9/26/1979
SHELL 1 (CORE HOLE)	SENW	27	270S	150E	WAYNE		7/14/1964
SHELL 4 (CORE HOLE)	SWSW	20	270S	150E	WAYNE		8/13/1964
SHELL 2 (CORE HOLE)	SESW	07	270S	150E	WAYNE		7/23/1964
SHELL 3 (CORE HOLE)	N-NE	09	270S	140E	WAYNE		8/3/1964

Historical Oil and Gas Production

Oil or natural gas have not been discovered within the SRD MLPA. All 79 wells drilled in the SRD MLPA were dry holes. The nearest producing oil and gas fields are located east of the SRD MLPA in the Moab Field Office. These fields are located from one to twenty-five miles from the eastern border of the SRD MLPA. To give some sense of what may be discovered in the SRD MPLA, the fields in the Moab Field office produce from reservoirs in both the Buried Fault Block Play (Play 2101) and the Fractured Interbed Play (Play 2103). The Fractured Interbed Play (Play 2103) extends into the SRD MLPA; however, the Buried Fault Block Play (Play 2101) may not extend into the SRD MLPA. Table 3 presents the cumulative production data for the oil and gas fields within the MMLPA which are due east of the SRD MLPA (Map 3), and includes seven active fields, four inactive fields, and one abandoned fields (BLM, 2012). Total cumulative production from these fields within the MMLPA has been roughly 9,530,761 barrels of oil and 17.4 billion cubic feet of natural gas. An additional area of interest within the Moab Field Office is the Greentown Field. It is located approximately two miles south of Green River Utah in the northwestern portion of the Paradox Basin. The discovery well was drilled in 2005 and has produced both natural gas and gas condensate. It has had cumulative production of 70,000 barrels of condensate as of April of 2016. Production from the field is from Pennsylvania clastic sections of the Paradox Formation at depths of around 9,500 feet. It is largely undeveloped at this time.

Table 3. Cumulative production of oil and gas fields in the MMLPA

Field Name	USGS Play #	Field Type	Producing Formation	Status	Discovery year	Active Wells	Cumulative Production Oil (bbl)	Cumulative Production Natural Gas (Mcf)
Big Flat/ Bartlett Flat	2101/03	Oil/Gas	Leadville/ Paradox	Active	1955	20	5,346,145	3,554,084
Big Flat West	2103	NA	Paradox	Inactive	1993	1	0	0
Cane Creek	2103	Oil	Paradox	Active	1925	2	64,418	34,082
Hatch Point	2101/03	Oil	Leadville/ Paradox	Active	1993	4	72,205	35,478
Hell Roaring	2103	Oil	Paradox	Active	1992	1	664,323	581,802
Lion Mesa	2103	Oil	Paradox	Inactive	1984	0	1,904	0
Long Canyon	2103	Oil	Paradox	Active	1962	1	1,153,330	1,199,576
Park Road	2103	Oil	Paradox	Active	1991	1	506,231	237,029
Salt Wash	2101	Oil	Leadville	Active	1961	3	1,653,689	11,750,597
Shafer Canyon	2103	Oil	Paradox	Abandoned	1963	0	67,554	63,805
Ten Mile	2103	Oil	Paradox	Inactive	1990	0	962	0
Golden Eagle*	2103	Gas	Paradox	Inactive	2006	2	0	0
					Total	35	9,530,761	17,456,453

Source: BLM, 2012 Table 5 & UDOGM, 2016
*Field undefined

Well Spacing

Utah Administrative Code R649-3-2 establishes well siting and spacing standards for the orderly development of an oil and gas pool. In Utah, standard well spacing for a vertical or directional oil and gas well is 40 acres. For horizontal wells, temporary spacing of 640 acres provides for anticipated pool development. The Utah Board of Oil, Gas and Mining has the authority to issue special spacing orders establishing drilling units or authorizing different well density or location patterns for particular pools to promote efficient development and protect correlative rights. For example, as fields mature, exceptions can be made to increase well density to maximize oil and gas recovery. The BLM generally defers to State of Utah well spacing.

Infrastructure

Road Systems

Interstate 70 (I-70) crosses the northern portion of the SRD MLPA with State Highway 24 forming the western boundary of the SRD MLPA. The primary roads providing access to oil and gas fields in the SRD MLPA are part of the Emery and Wayne County Class B road systems and are maintained by the counties on a regular basis. Numerous secondary roads connecting to the B road systems would provide access to potential individual wells and facilities. Class B road systems in the SRD MLPA are shown on Map 1.

Pipeline Systems and Gas Plants

There are no interstate gas pipeline systems in the SRD MLPA. The nearest interstate pipelines to the SRD MLPA are the Williams Pipeline which transports gas, and Enterprise Products Partners, L.P. Pipeline which transports natural gas liquids. The interstate pipelines are within a designated utility corridor that parallels portions of I-70 and Highway 191 (Map 3). The two pipelines are buried side-by-side except in the northeast part of the MMLPA where the 26-inch Williams Pipeline takes a more direct route northeast from the junction of Highway 191 and Highway 313 through Arches National Park.

There are no gas plants within the SRD MLPA. There is a small gas plant approximately 10 miles east of the SRD MLPA, located roughly 14 miles southeast of the town of Green River. A second, larger gas plant is located near Canyonlands Field (Moab airport) approximately 15 miles east of the SRD MLPA.

Produced Water and Disposal Facilities

There is currently no water injection/disposal well within the SRD MLPA, (UDOGM, 2016).

There are no commercial water disposal facilities within the SRD MLPA. The nearest commercial water disposal facilities to the east are located along the I-70 corridor. Approximately 50 miles east of the town of Green River along I-70, at an area known as Danish Flat, is an evaporation pond disposal facility operated by Oilfield Water Logistics. Further along I-70 at Harley Dome, approximately 65 miles east of the town of Green River near the Colorado border, is the Harley Dome #1-X SWD disposal well operated by New Water Financial, LLC.

Hydrogen Sulfide Gas (H_2S)

Hydrogen Sulfide (H_2S) is a poisonous gas that can occur in association with oil and gas operations. The Mississippian Leadville Limestone is known to contain naturally high concentrations of H_2S. Any production from this formation in the SRD MLPA would have the potential to encounter H_2S. One well in the Moab Field Office in the Hatch Point field (the Hatch Point No. 1) is reported to have had some H_2S in the past (BLM, 2012). H_2S can also develop in wells used for water injection, particularly when the injection zone also contains oil.

Conflicts with other Mineral Development

As discussed below in section VII, the SRD MLPA has potential for oil and gas development. In addition to potential for development of oil and gas resources in the SRD MLPA, there are also high occurrence potentials for potash, salt, clay, sand, gravel, silica, gypsum, uranium and associated vanadium (BLM, 2002; BLM, 2005). There is little potential for conflict between oil and gas and other mineral development, except for potash, if it were to be developed. Known potash zones in the Paradox

Formation generally tend to be stratigraphically above the known oil and gas zones in the same formation, however, because the entire formation is suitable for the occurrence of either resource, there is potential for conflict. In addition the development of both resources simultaneously (with similar surface effects) would concentrate the intensity of surface use in a given area. Through the use of directional drilling and careful placement of potential oil and gas wells and facilities, it would be possible to mutually develop oil and gas and other mineral resources such as sand and gravel.

VI. Oil and Gas Occurrence Potential

The oil and gas occurrence potential within the Price and Richfield Field Offices is described in detail in the Mineral Potential Reports (MPRs) for the Price and Richfield Field Office RMPs. As described in the MPRs, the oil and gas plays covering the SRD MLPA have a high potential for the occurrence of oil and gas (BLM, 2002; BLM, 2005).

VII. Oil and Gas Development Potential

As described in the Price and Richfield Field Office MPRs and summarized in section III above, two oil and gas plays, the Fractured Interbed Play (2103) and the Salt Anticline Play (2105), are shown to underlie the SRD MLPA in USGS, (1995). The Fractured Interbed Play is associated with the commercial production of oil and gas in the adjacent Moab Field Office and has development potential (BLM, 2002; BLM, 2005, BLM 2012) within the SRD MLPA. A third play, the Buried Fault Block Play (Play 2101), is an oil & gas producing play within the Moab Field Office which could extend into the SRD MLPA and could have development potential within the SRD MLPA. The oil and gas plays within the SRD MLPA are shown on Map 2.

The fields in the Moab Field Office, which are adjacent to the SRD MLPA, produce from reservoirs in both the Buried Fault Block Play (Play 2101) and the Fractured Interbed Play (Play 2103) (USGS, 1995). The Fractured Interbed Play (Play 2103) extends into the SRD MLPA; however, the Buried Fault Block Play (Play 2101) may extend into the SRD MLPA. All of the 15 oil and gas fields in the MMLPA produce from reservoirs in the Buried Fault Block and/or the Fractured Interbed Play (Play 2101 and Play 2103, respectively). The Buried Fault Block Play underlies all but a small area in the southwest part of the MMLPA and the Fractured Interbed Play underlies the entire MMLPA. Within the MMLPA, there has been no commercial production of oil and gas from reservoirs in the Cretaceous Dakota to Jurassic Play (Play 2004) or the Salt Anticline Flank Play (Play 2105). All commercial production of oil and gas from these two plays is from nearby fields in the Fold and Fault Belt of the Paradox Basin. Play 2004 underlies a small area in the northern part of the MMLPA and Play 2105 is present in all but a small area in the southwest part of the MMLPA (BLM, 2012).

It is anticipated that most of the potential development in the SRD MLPA during the next 15 years will likely occur in the Fractured Interbed Play (2103) and potentially the Buried Fault Block Play (2101) if they are found to extend into the SRD MLPA given the existing adjacent fields in the Moab Field Office within these plays. The increased drilling success rates due to continued technological advances being made in the areas of horizontal drilling, fracture identification tools, hydraulic fracture stimulation, underbalanced drilling, and completions in fractured shales, all of which will help in the discovery of new fields in reservoirs that are moderate in size with more than minimal oil columns should also increase the potential for development within the SRD MLPA. In addition to the Cane Creek Shale, there are other organic shales, notably the Chimney Rock, Gothic, and Hovenweep Shales, that may also provide new drilling targets for hydrocarbon accumulations. Some development may occur in the Salt Anticline Flank play (Play 2105) as seismic technology continues to improve, allowing better definition of the location and nature of the structural traps in the play and promoting increased drilling and recompletion opportunities along the flanks of the salt anticlines (BLM, 2012).

VIII. RFD Baseline Scenario Assumptions

Assumptions for Deep Wells

Since deep wells have not been drilled in the SRD MLPA, the assumptions that were used for the MMLP RFD (BLM, 2012) for deep wells will be used for potential development within the SRD MLPA. A few deep wells (10,000 feet or deeper) have been drilled in the MMLPA. Three deep wells were drilled in the eastern Paradox area between 2006 and 2010 (UDOGM, 2012). It is likely that some deep wells will be drilled in the next 15 years within the MMLPA. The likelihood of a deep well being drilled is highest in the eastern Paradox area, but it is also feasible in other areas of the MMLPA. The drilling of a deep well requires a larger drill rig and a larger drill pad, typically 400 feet by 450 feet (4.1 acres). The typical vertical well in the MMLPA is 7,000 to 9,000 feet deep and normally requires a drill pad of approximately 250 feet by 350 feet (2 acres). Although the size of a well pad for a deep well would be larger than a well pad for a typical vertical well, the expected number of deep wells is relatively few in comparison to the total number of wells likely to be drilled during the next 15 years. Therefore, for purposes of RFD projections, the relatively few expected deep wells would not substantially affect the long-term average drill pad size for the MMLPA. Depending on the depth, total drilling time for a deep well can be significantly longer than a typical vertical well with the time being 6 to 12 weeks for deep wells and 2 to 4 weeks for typical vertical well (BLM, 2012).

Assumptions for Horizontal Wells

Since horizontal wells have not been drilled in the SRD MLPA, assumptions that the MMLPA RFD used for horizontal wells would be reasonable for potential development within the SRD MLPA. Horizontal drilling technology has been used in the MMPLA to target unconventional reservoirs in the Fractured Interbed Play which is one of the most likely plays for development within the SRD MLPA. This technology has been used successfully in the Big Flat, Hatch Point and Salt Wash areas to produce oil from the Cane Creek Shale of the Paradox Formation. The Cane Creek Shale is an ideal target for horizontal drilling because it is a fractured self-sourced oil reservoir that is highly over pressured. Horizontal drilling increases the probability of encountering the near-vertical fractures needed for economic oil production. The use of horizontal drilling in the Cane Creek has greatly improved the success rate of new economical discoveries (Chidsey, 2004). Most of the Cane Creek discoveries since 1990 have been made using horizontal drilling technology. The success of horizontal drilling in the Big Flat (approximately 12 miles east of the SRD MLPA) and Hatch Point (approximately 25 miles SE of the SRD MLPA) areas suggests that horizontal drilling will continue in these areas and may lead to new discoveries in the MMLPA, particularly as technology advances are being made in the areas of horizontal drilling, fracture identification tools, hydraulic fracture stimulation, underbalanced and managed-balance drilling and completions in fractured shales (BLM, 2012).

Based on past drilling in the MMLPA, a typical horizontal well requires a 4.4 acre drill pad (roughly 440 feet by 440 feet) in comparison to a 2-acre drill pad for a typical vertical well. The larger pad size for a horizontal well is to accommodate a larger drill rig and sufficient area for additional equipment such as, specialized mud systems, directional tools, drill pipe and casing, and portable storage tanks (BLM, 2012).

It is estimated that the majority (60-80 percent) of new drilling in the MMLPA during the next 15 years will be accomplished using horizontal drilling technology to test the Cane Creek Shale or similar fractured shale interbeds of the Paradox Formation. Depending on the length of lateral sections, drilling time for a horizontal well in the MMLPA is typically 6-8 weeks (BLM, 2012). The SRD MLP could follow a similar development scenario if oil and gas is discovered within the SRD MLP.

The BLM expects that directional and horizontal drilling technology will be used in the MMLPA during the next 15 years to: (1) drill multiple wells from the same well pad, or (2) drill multiple laterals from a single vertical wellbore (BLM, 2012). A similar development scenario could also develop within the SRD MLP if oil and gas are discovered.

Projected Level of Oil and Gas Activity

In addition to local geology, reasonable projections of future oil and gas activity in the SRD MLPA can be made based on consideration of current and forecasted market conditions, historical drilling activity, and professional judgment.

Current and Forecasted Trends in Crude Oil and Natural Gas Markets

Crude oil is traded widely on the world market, largely because crude oil and the fuel products derived from it are highly transportable at low pressure. This means that although there are regional price influences, the global marketplace establishes the price of locally produced oil. Demand for liquid fuels, including crude oil derived fuels and biofuels, is primarily driven by transportation. Domestic crude oil production has increased in recent years but due to a slowdown in the world economy there has been a drop in demand which has resulted in a major decrease in price for both crude oil and natural gas. Production of both crude oil and natural gas is expected to decline in 2016 and the decreased production would be expected to continue until the world economy turns around which would result in an increase in demand for crude oil and natural gas. By 2020, domestic crude oil production is expected to level out with a slight decrease through 2040. Likewise, biofuels production, which is largely domestically produced, is expected to continue to increase when the economy improves. These conditions will decrease the volume of imported crude oil; however, oil imports will continue to be an important source of crude oil through 2040. The U.S. Energy Information Administration (EIA), in an overview of its Annual Energy Outlook for 2015, projects the price of oil to escalate gradually and continuously through the year 2040 (final year of the projection), at which time a barrel of crude oil would be $141 in 2013 dollars (EIA, 2015).

The trade of natural gas is more closely tied to pipeline infrastructure than crude oil. Because of this, gas is traded on a regional and continental basis, rather than globally, like oil. This results in sometimes dramatic regional price variation. Exploration and development of domestic natural gas has been so successful in recent years, particularly through advances in shale gas production, that supply has outreached demand, resulting in a sharp decline in natural gas prices even while crude oil prices have surged. The use of natural gas as a transportation fuel has not been widely developed, so the end uses that drive its demand are substantially different than with crude oil. Although the two are produced commonly, the difference in their respective end uses, in part, accounts for the wide gap that has developed in recent years between the values of oil and natural gas, on a Btu basis. Natural gas prices are presently very low, both in terms of historical trend, and relative to oil on a Btu (energy equivalency) basis. The EIA projects natural gas prices to escalate to a final projected price of $7.85 in the year 2040 (corrected to 2013 dollars) (EIA, 2015).

For the purpose of projecting potential oil and gas exploration activity in the SRD MLPA, it is assumed that the demand and price for crude oil and natural gas will strengthen in the future and will generally improve during the 15-year planning term.

Historical Drilling Trends for Development Areas

Historical drilling activity can be used as an indicator for estimating future drilling activity. The information below includes private, State, and Federal lands within the SRD MLPA.

There have been a total of 79 wells drilled in the SRD MLPA. All of the 79 wells drilled were dry holes and were plugged and abandoned (P&A) (Table 2). No new wells have been drilled in the SRD MLPA since 1990. To get a perspective of the potential for oil and gas development within the SRD MLPA, a survey of what has occurred in the Moab Field Office in adjacent oil and gas fields would be instructive. Well drilling in the Moab Field Office has had a good success rate in the eight year period from 2006 – June 2014 (Jones, E. C., 2016). During that period, the drilling success rate increased to 52 percent due largely to the successful use of improved horizontal drilling technology in targeting unconventional reservoirs in the Cane Creek Shale. All but 4 of the 27 wells drilled in the MMLPA since 2007 were drilled within the Salt Wash-Big Flat and Hatch Point areas (See Map 3). The Salt Wash field is 2 miles east of the SRD MLPA and the Hatch Point area is approximately 25 miles southeast of the SRD MLPA. This gives a six-year combined average for these two areas of nearly four wells per year (BLM, 2012). Using improved horizontal drilling technology in targeting unconventional reservoirs, the SRD MLPA would have the potential to have successful wells completed similar to the results found within the Moab Field Office for drilling unconventional reservoirs such as in Play 2103 where the Paradox is the producing formation.

Although previous activity can be an indicator of future activity, the reliability of these forecasts is limited by unforeseen factors, such as changes in economic conditions and technology and the SRD MLPA would have to prove to have the same viability as the plays in the Moab Field Office. For the SRD MLPA, a discovery well would have to be drilled and other wells would need to be drilled to prove the viability of a new field within the SRD MLPA.

Projected Drilling Activity for SRD MLPA

In order to project future drilling activity, the following assumptions were made:

- The demand and price for crude oil will regain strength (the MMLP RFD was completed in 2012 with the average price of oil at $94.05 per barrel (USEIA, 2012) and the current price in October 2016 stands at $49.76 per barrel (USEIA, 2016))
- Economic quantities of oil and gas will be discovered within the SRD MLPA
- The drilling activity in the SRD MLPA could be similar to the Moab Field Office should unconventional continuous type discoveries be made in the Paradox Formation in the SRD MLPA.

The SRD MLPA has not had a successful discovery of oil & gas but the MMLPA has had oil and gas discovery and production immediately east of the SRD MLPA and therefore, leads to the possibility that oil and gas may also be found in the SRD MLPA. The majority of all drilling in the MMLPA during the past 30 years has occurred in the Salt Wash-Big Flat and Hatch Point areas. Nearly 76 percent of the total wells drilled in the MMLPA during the last 30 years were in these two areas. These two areas contain all of the producing oil and gas fields in the MMLPA. Drilling activity since 2007 has averaged four wells per year in the Salt Wash-Big Flat areas. It is projected that the average number of wells drilled per year in the Salt Wash-Big Flat area will be four wells per year. This projection is based largely on past drilling and on recent trends in drilling activity in the area, including an increase in drilling and drilling success rate as a result of improved horizontal drilling technology (BLM, 2012).

Using the Moab Field Office Salt Wash–Big Flat development area as a template for the SRD MLPA, it could be projected that an upper average of four wells could be drilled per year in the SRD MLPA. A discovery well would first have to be drilled within the SRD MLPA and it is common for oil and gas companies to spend several years delineating and proving a new discovery. One to two wells drilled per year in the discovery phase of development would be reasonable with a ramping up to two to four wells per year in the latter years of development within the SRD MLPA. A total of up to 30 exploration and development wells within the next 15 years or an average of two wells per year would be reasonable.

Future drilling is affected by economic situations that cannot be accurately forecasted; therefore, an average was utilized to reflect the potential numbers of future wells. It is recognized that future drilling activity and future wells will not be evenly distributed throughout the development areas. When new wells are drilled, and especially if new fields are discovered, there could be additional drilling activity concentrated around the new wells.

The average annual drilling projections are not thresholds for limiting future annual drilling activity. It is recognized that there would be some years when annual drilling activity would be much less than the projected average and other years when annual drilling activity could exceed the average number of wells projected.

The average of two wells projected per year would be dependent upon a productive area being discovered and successfully developed. Horizontal drilling technology has been used successfully in the MMLPA to target unconventional reservoirs in the Cane Creek Shale of the Paradox Formation. The use of horizontal drilling in the Cane Creek has greatly improved the success rate of new economical discoveries (BLM, 2012). The upward trend in drilling activity between 2007 and 2015, and the increased drilling success rates in the Moab Field Office, combined with forecasted market conditions, favor interest in developing the SRD MLPA and future exploration and development drilling.

IX. Surface Disturbance Due to Oil and Gas Activity on All Lands

A wide range of variables will affect the surface disturbance from oil and gas drilling and production operations in the SRD MLPA. Factors affecting the estimates for future surface disturbances include the size of the well pad, the topography, the length of access road and pipelines, and the reclamation time frames.

The Price RMP Reasonably Foreseeable Development Scenario projected that drill pad sizes could range from 1.0 acres to more than 3.5 acres per well pad. The Richfield RMP Reasonably Foreseeable Development Scenario projected that the drill pad size would be 4 acres. The primary factor affecting the size of a well pad is the size of the drill rig needed to reach the total depth of the well. A more recent look at potential well pad size would be the MMLPA pad sizes. The typical size of existing well pads in the MMLPA is 2 acres for a vertical well (excluding deep wells) and 4.4 acres for a horizontal well. The use of horizontal drilling in the Cane Creek has greatly improved the success rate of new economical discoveries. For this reason, it was assumed that 60 to 80 percent of new wells in the MMLPA would be drilled using horizontal technology which would likely increase the drilling success rate to 50 to 70 percent (BLM, 2012). It is reasonable to project that potential well pads within the SRD MLPA would be similar in size to the Moab Field Office well pads since horizontal drilling in the Fractured Interbed Play (Play 2103) for both field offices in similar topography would need similar size pads. This would lead to the SRD MLPA having horizontal well pads of approximately 4.4 acres in size. Taking into account the smaller pad size of vertical wells, the average pad size for wells in the SRD MLPA would be approximately four acres.

Based on a review of the Emery and Wayne County road systems, there are 203 miles of roads within the SRD MLPA that would provide access to potential oil and gas wells and associated well facilities. The Price RMP Reasonably Foreseeable Development Scenario projected the average length of each well access road would be ¾ of a mile with an average disturbance width of 70 feet (6.4 acres) of initial disturbance. After reclamation, the average road disturbance would be 20 feet total width for 3/4 mile per well pad (1.8 acres). The county Class B roads, State Highways and paved roads were not included in the mileage estimate. Potential oil and gas activities in the SRD MLPA would not be the primary use of these roads. These roads are considered a permanent part of the Emery and Wayne County road infrastructure and will not be reclaimed upon cessation of oil and gas activity.

Other factors to consider for estimating future surface disturbance is the time required for reclamation. It is assumed that all surface disturbances associated with well drilling and production operations would be successfully reclaimed within a scope of 10 years, depending on soils, vegetation, and rainfall (BLM, 2012).

Geophysical operations are temporary in nature and do not require the use of mechanized earth moving equipment to construct new roads or to prepare drill sites. Although geophysical operations may crush vegetation and cause soil compaction, they do not result in the complete clearing or removal of vegetation. Therefore, surface disturbance caused by geophysical operations typically requires less time to reclaim (1-5 years) than does the surface disturbance resulting from well drilling operations, including the construction of roads, drill pads and buried pipelines. The average length of time needed to successfully reclaim surface disturbances caused by geophysical operations is assumed to be three years. There are no existing surface disturbances attributed to geophysical operations in the SRD MLPA since there have been no geophysical operations conducted in the SRD MLPA during the past seven years.

In addition to final reclamation, interim reclamation is done on portions of well sites and pipelines which are not needed for production and maintenance operations, and on areas of access roads that are not needed for vehicle travel. This minimizes the footprint of construction disturbances, including well pads, pipelines and roads. The amount of interim reclamation can vary widely for each disturbance depending on factors such as topography and area needed for future workover rigs and other equipment use and access. It is estimated that the footprint of each new construction disturbance in the SRD MLPA would be reduced by 25 to 50 percent through interim reclamation (Price RMP Reasonably Foreseeable Development Scenario, 2008).

The 79 wells drilled in the SRD MLPA have been plugged and abandoned. Sufficient time (more than 25 years) has passed since the last wells were plugged so it is reasonable to assume that reclamation is successful.

<u>Estimated Existing Surface Disturbance</u>

There is no existing surface disturbance for P&A oil and gas wells and access roads within the SRD MLPA. The most recent well drilled in the SRD MLPA was plugged and abandoned in 1990, over 25 years ago. There are no existing surface disturbances attributed to geophysical operations in the SRD MLPA since there have been no geophysical operations conducted in the SRD MLPA during the past seven years.

<u>Total Estimated Future Surface Disturbance for Well Pads, Roads, and Pipelines</u>

It is assumed that that there would be an average surface disturbance of four acres per well pad, 6.4 acres for the ¾ mile, 70 foot wide access road and gathering pipeline ROW per well during the next 15 years. An additional amount of disturbance would be the acres needed to construct a projected main pipeline to take the field produced gas to an interstate pipeline.

The total length of a main pipeline to transport natural gas or natural gas liquids from the SRD MLPA to the Williams Northwest Gas Pipeline or Enterprise Products Partners, L.P. interstate pipelines would be approximately 30 miles. The average pipeline disturbance construction width would be 75 feet and the long term ROW width would be 50 feet. This gives a total pipeline disturbance of 273 acres. The total pipeline disturbance would be expected to be fully reclaimed within 10 years.

Total surface disturbance per well, including well pad (four acres) and access roads and gathering pipelines (6.4 acres) for 30 wells would be 10.4 acres per well or a total of 312 acres of surface disturbance resulting from oil and gas drilling and production activity during the next 15 years (Table 4). This estimate is for the average surface disturbance during future drilling, but it is not a threshold for limiting future exploratory drilling programs.

The success rates for wells drilled in the SRD MLPA could be similar to the Moab Field Office success rates just east of the SRD MLPA. The MMLPA had drilling success for horizontal wells in the MMLPA. The MMLP assumed that 60 percent of the 128 wells drilled (77 wells) would be productive and 40 percent (51 wells) would be dry holes which would be abandoned and successfully reclaimed within a 10-year period within the MMLPA (BLM, 2012). Using the MMLPA area numbers of 60 percent being productive wells and 40 percent would be dry holes of the 30 projected wells to be drilled in the SRD MLPA area there would be 18 productive wells which would result in 187 total acres of surface disturbance for productive wells. The 12 projected dry holes would have 125 acres of disturbance. The total surface disturbance for all 30 wells would be 312 acres. It is estimated that the surface disturbance (footprint) associated with each new productive well in the SRD MLPA would be reduced by 50 percent through interim reclamation during the next 15 years. Interim reclamation of surface disturbances associated with the 18 productive wells would total 94 acres.

Table 4. Surface Disturbance from drilling and reclamation activities in the SRD MLPA

	Wells	Total surface disturbance acres
Existing surface disturbance *Plugged and Abandoned wells (PA)*	79	0
Future surface disturbance for the next 15 years *Projected Main Pipeline* *Well Pads, Roads, gathering pipelines*	 - 30	 273 312
TOTAL		585
Predicted reclamation in the next 15 years *Interim Reclamation of future producing wells** *Reclamation of future dry wells*** *Main Pipeline***	 18 12 -	 94 125 273
TOTAL		492***

*Interim reclamation of 50% of construction
**Final reclamation is estimated to take up to 10 years
***492 reclaimed acres would be composed of both lands that have reached final reclamation status and lands still under reclamation.

In summary, the estimated total surface disturbance for future wells, roads, and pipelines in the SRD MLPA is 585 acres for the 30 wells projected over the next 15 years. At the end of the fifteen years there would be 93 acres in use for producing wells and the remaining 492 acres would be either reclaimed or in interim reclamation status. It is assumed that none of the productive wells would be abandoned in the first 15 years of production.

Total Estimated Future Surface Disturbance for Geophysical Exploration

Geophysical exploration operations have been conducted throughout the entire SRD MLPA in the past (Map 4). Although geophysical data may have been collected from an area in the past, previous geophysical activity does not preclude the gathering of additional data. Old data can be reprocessed, but there are limits to the quality of data that can be interpreted from the older data. Based on past geophysical activities, it is reasonable to assume that new geophysical exploration could occur anywhere within the SRD MLPA during the next 15 years.

In the past, geophysical operations in the SRD MLPA utilized either two-dimensional (2-D) or, more recently, three-dimensional (3-D) data acquisition technology (BLM, 2007). The activities require spreading cables and geophones for receiver lines and utilizing vibroseis trucks or shotholes along source lines to supply the source of energy for creating seismic reflections (seismic acoustic waves). Vibroseis buggies or buggies transporting drills typically travel cross-country. Buggies transporting drills usually follow a single route and make a single pass or round trip along the source lines. Vibroseis buggies have normally been run in single file with each buggy following the previous buggy. However, vibroseis buggies can be spread three to four abreast and run parallel to each other when recording source lines. The buggy routes can be zig-zagged (weaved) to avoid long, straight visual impacts. When vehicles travel cross-country, there is no dozing of vehicle access routes. The surface impacts from the buggies are the vehicle tracks along the buggy routes and a drill hole if it is a shothole project. Helicopters are utilized to distribute receiver cables on most big projects and for moving portable drilling equipment in terrain that is too steep for buggies. Some companies and/or geophysicists prefer vibroseis technology for gathering data, because the frequency of the source can be varied and data can be collected at several different frequencies while the vibroseis buggy is on the line. The depths and types of formations may also affect the preference of one type of source equipment over another.

Past geophysical projects are good indicators of project parameters for future geophysical surveys in the SRD MLPA. The distances between the receiver lines and the distances between the source lines would vary depending upon the depth of the target formations. For shallow depths the receiver/source lines for a 3-D project would be approximately 660 feet apart, and there would be 11 linear miles of source lines for every one square mile of project area. Based on the previous 3-D project and depths of the potential oil and gas containing formations (7,000 – 9,000 feet deep) throughout the majority of the SRD MLPA, most of the 3-D projects in the SRD MLPA would likely have source lines spaced at roughly 660 feet intervals with an average of 11 linear miles of source lines per square mile of project area.

The San Rafael Saddle 3-D geophysical project (See Map 4) was conducted within the SRD MLPA December 2007 – February 2008. The project area encompassed approximately 61 square miles (Map 4). The project utilized viroseis buggies (BLM, 2007) to generate sound waves through the ground into subsurface formations. Survey parameters for the project included 136 source lines spaced 660 feet apart totaling 685 linear miles. This equates to 11 linear miles of source lines for each square mile of project area. A 30 to 60 square mile area could be typical for future 3-D projects in the SRD MLPA during the next 15 years. An average 40 square mile 3-D project would require at least 440 linear miles of source lines where a vibroseis buggy or drill buggy would be driven. Depending on the network of existing roads and trails in the project area, it may be feasible to move some of the source points to the roads and avoid some cross-country travel with the buggy vehicles. The use of heli-portable drills in steeper terrain would also reduce the amount of source line traveled by vibroseis buggies or drill equipment.

During the past 30 years, geophysical exploration in the SRD MLPA has included one project, the San Rafael Saddle 3-D Geophysical Project, as described above. A more likely scenario for the SRD MLPA, if a discovery of oil and gas is made, would likely be similar to what has occurred in Moab Field Office. The MMLPA has averaged at least 27 linear miles of source lines per year. However, during the past 15 years, considered in the MMLPA, the average increased to 36 linear miles of source lines per year due largely to an increase in the size of 3-D projects and an increase in the overall percentage of 3-D projects compared to 2-D projects. The recent decrease in the price of oil and gas has resulted in a major decrease in oil and gas activity. This may continue for some time. A renewal of interest in geophysical exploration could take place in the SRD MLPA with the recovery of oil and gas prices.

In addition to 3-D projects, it could be anticipated that some 2-D projects could occur in the SRD MLPA during the next 15 years. Based on the MMLPA past projects, future 2-D geophysical surveys could vary from one-to-two lines that are one-to-two miles in length, or multiple lines several miles long within the SRD MLPA.

Projections for future geophysical exploration projects in the SRD MLPA are based on the following assumptions:

1. Geophysical exploration would be cyclic and would increase at times to correspond with increases in other oil and gas activity and taking into account that the 15 year term starts with no geophysical projects likely to take place for some time due to poor economic conditions;
2. Geophysical exploration in the SRD MLPA could be projected by what has occurred during past years within the MMLPA and would form a reasonable basis for projecting future geophysical activity in the SRD MLPA if an initial oil and gas discovery is made within the SRD MLPA;
3. Data acquisition would involve the use of 2-D, 3-D, or similar technology;
4. Measuring the exploration in linear miles of source lines would be more meaningful than the number of geophysical projects;
5. An estimate of four linear miles of source lines for every square mile of geophysical would be a conservative representation for the majority of projects in the SRD MLPA and would take into account the average of a mixture of 2-D and 3-D projects;
6. Surface disturbance would be successfully reclaimed within three years.

Using these assumptions, the 15-year projection for geophysical exploration on Federal, State, and private lands within the SRD MLPA would average 18 linear miles of source lines per year, or a total of 270 linear miles of source lines. This projection takes into account the average linear miles of source lines for the past 15 years (36 linear miles per year) which has taken place within the MMLPA and taking 50% of that value due to the uncertain nature of finding a new discovery of oil & gas and also the current depressed state of oil & gas exploration and development.

It is assumed that reclamation of surface disturbance would be successful within a scope of 3 years depending on reclamation times related to soils, vegetation, and rainfall. The 3 year reclamation time span is very conservative as the San Rafael Saddle 3-D Project was reclaimed in a 1 year time frame (BLM, 2008b). Therefore, surface disturbance resulting from geophysical activity during the first 12 years would be successfully reclaimed over the next 15 years. Assuming an average disturbance width of 10 feet for each of the 18 linear miles of projected source lines, the total surface disturbance would be 22 acres per year or 330 acres over the next 15 years. Using an average surface disturbance of 22 acres per year, total surface disturbance that would be reclaimed during the next 15 years would be 264 acres. Subtracting the acres projected to be reclaimed (264 acres) from the acres projected to be disturbed (330 acres), gives a net surface disturbance of 66 acres during the 15-year period.

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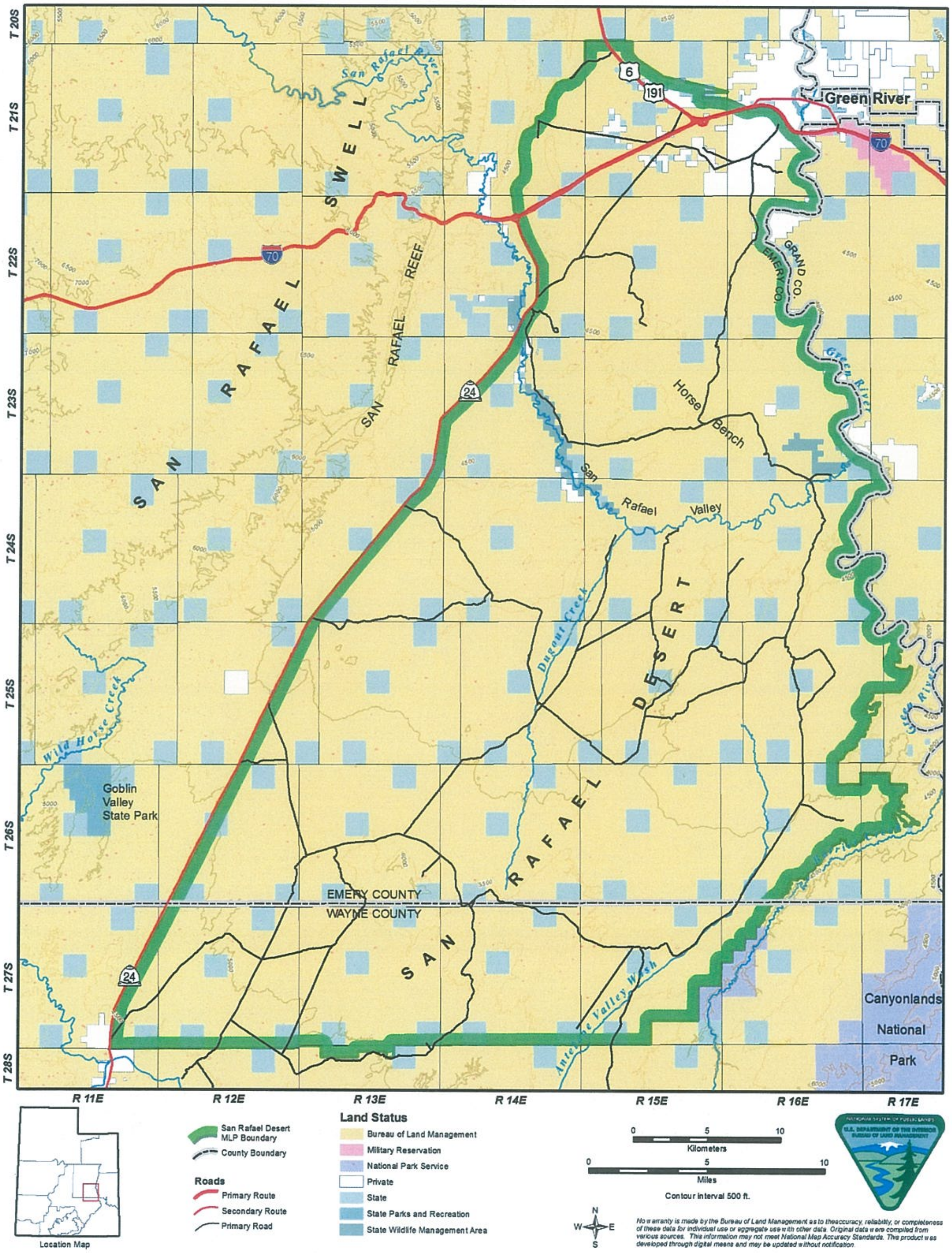
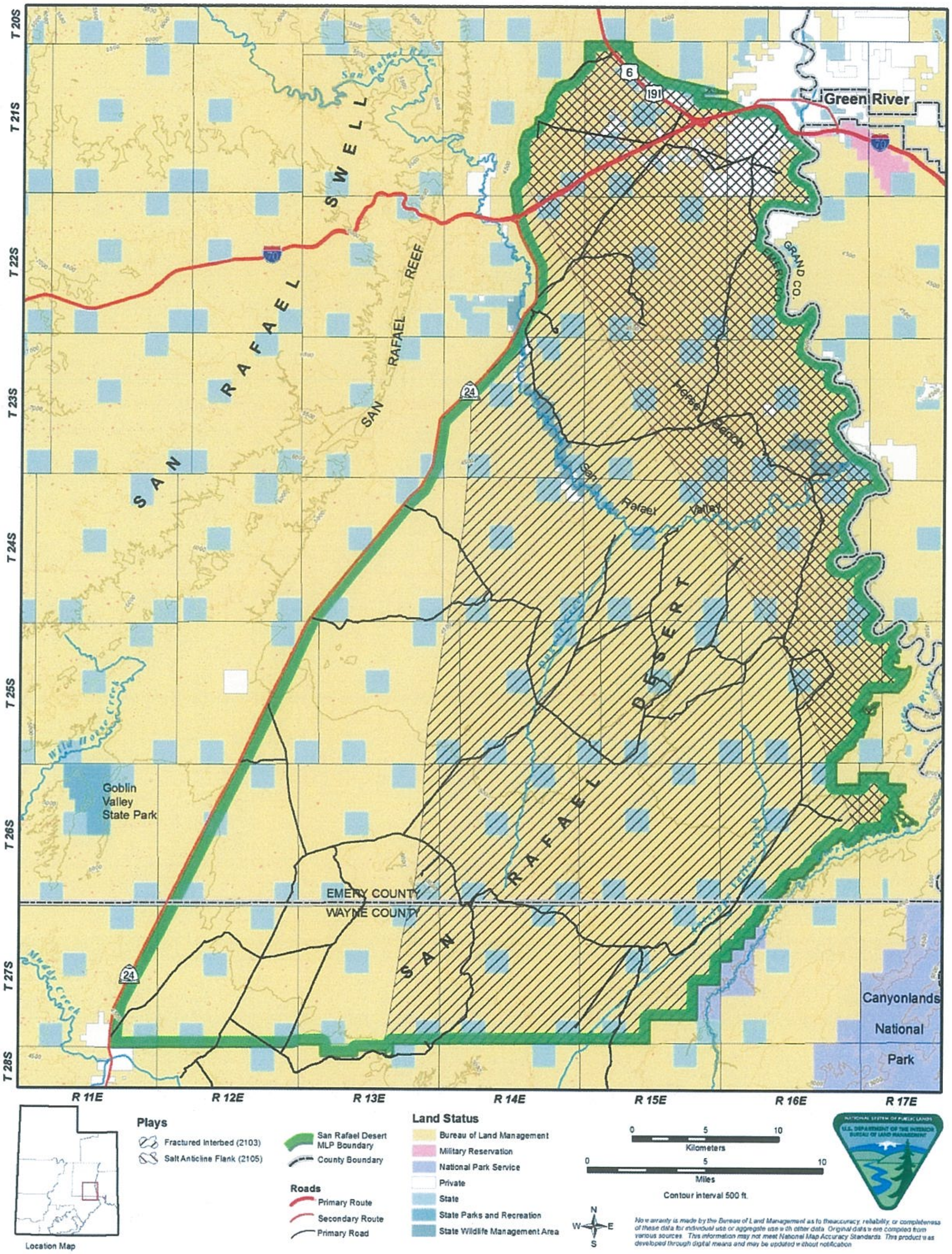
APPENDIX – A

Maps 1 – 5

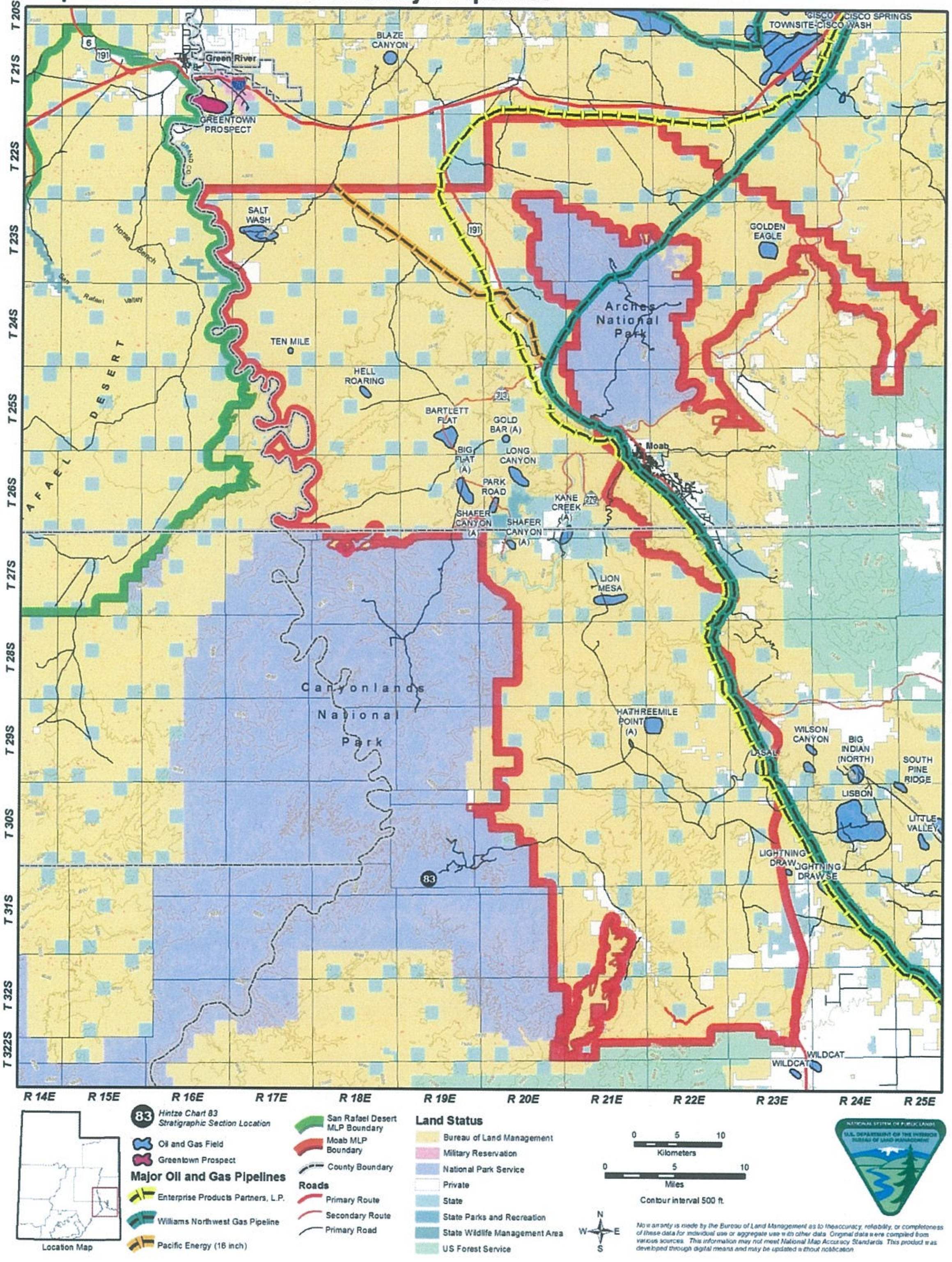
Map 1 - San Rafael Desert Master Leasing Plan Area



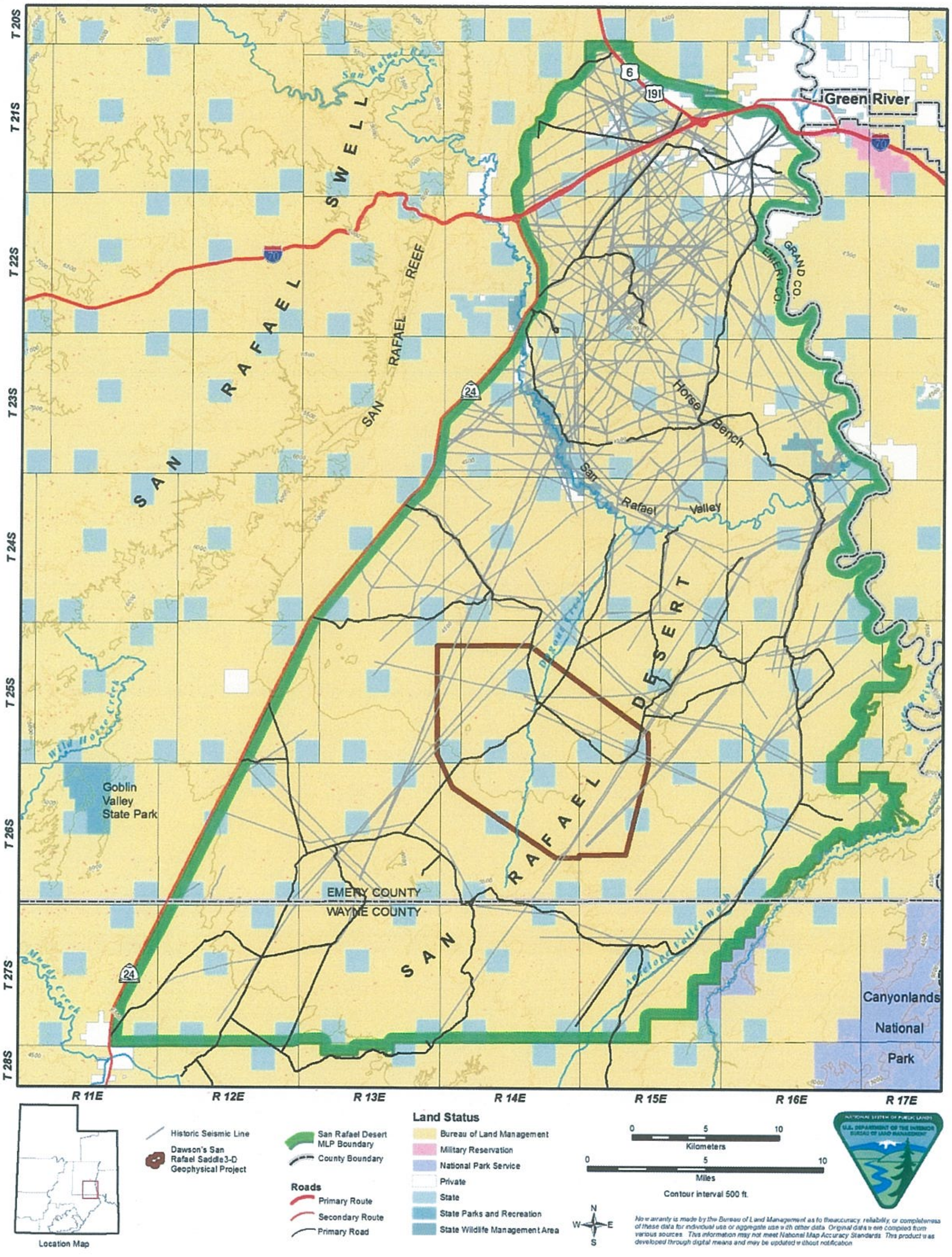
Map 2 - Oil and Gas Plays



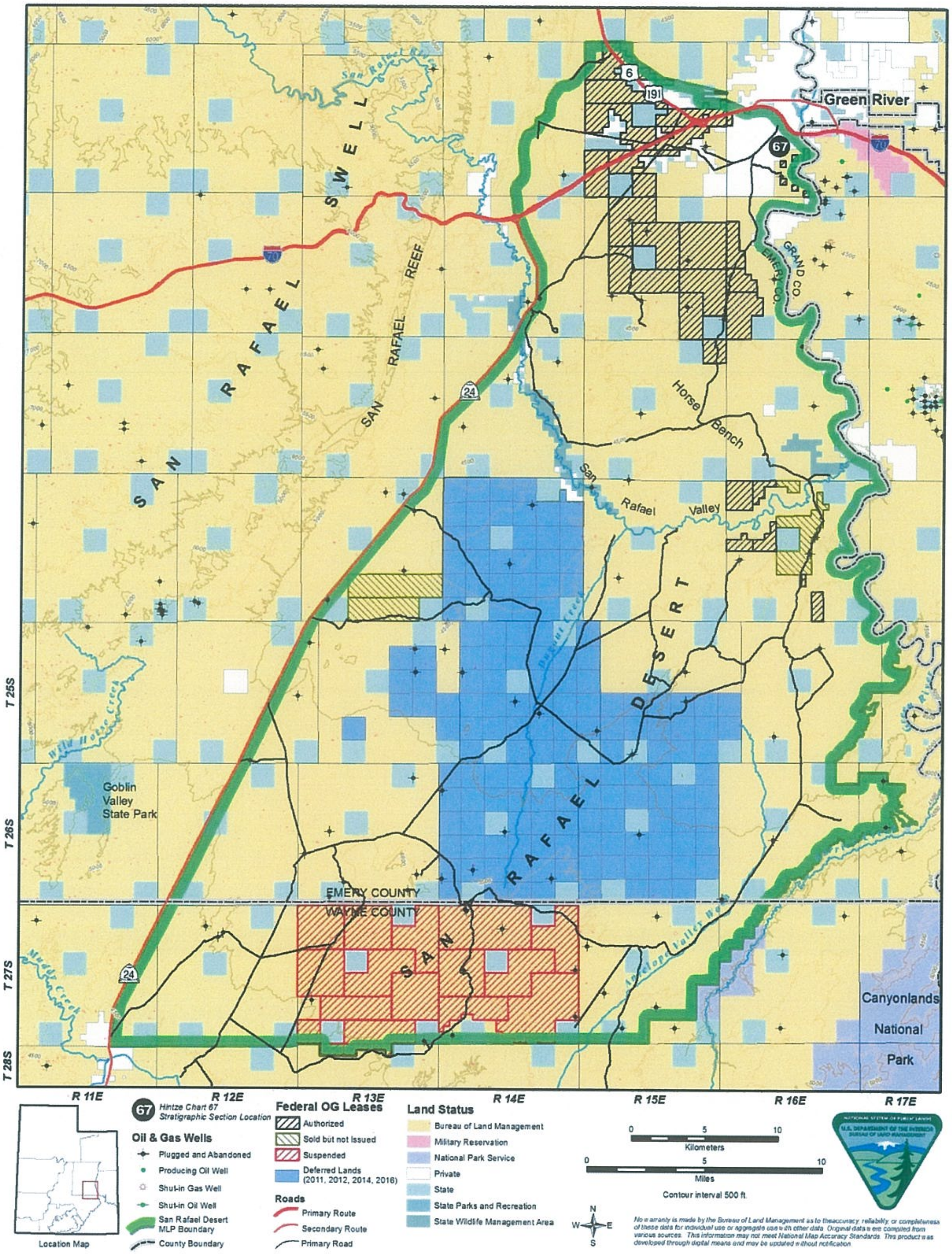
Map 3 - Oil and Gas Fields with Major Pipelines



Map 4 - Geophysical Surveys



Map 5 - Oil and Gas Wells with Federal Oil and Gas Leases



APPENDIX – B

Charts

Chart **67**

GREEN RIVER AREA

			FEET	
Q		Alluvium, pediment dep	0-100	
T		Tuscher Fm	400	
CRETACEOUS	Mesaverde Group	Farrer Fm	700	barren
		Bluecastle Ss Tongue	100-130	tongue of Castlegate Ss
		Neslen Fm	200-250	thin coal at base
		Sego Sandstone	50-150	
		Buck Tongue-Mancos Sh	0-50	
		Castlegate Ss	80	
		Blackhawk Fm	140	thin coal beds
		Grassy Ss	0-100	
		Sunnyside Ss	100-0	
		Mancos Shale tongue	100-200	
		Kenilworth Ss	50-150	
	Mancos Shale	Pierre fauna; Telegraph Creek fauna; Niobrara fauna	3000	*Scaphites*; *Inoceramus*; *Baculites*; *Desmoscaphites*; *Ostrea*
		Ferron Ss M	10-30	
		Tununk Mbr	350-400	*Collignoceras*; *Pycnodonte newberryi*
		Dakota Sandstone	0-30	
	Cedar Mountain Fm		150-180	
		Buckhorn Cg M	0-30	
JURASSIC	Morrison Fm	Brushy Basin M	240-420	
		Salt Wash Mbr	160-290	
		Tidwell Member	20-50	J-5 unconformity
		Summerville Fm	100-400	red siltstone
		Curtis Formation	130-230	green
		Entrada Ss	410-470	stone goblins
		Carmel Formation	220-300	gypsum; J-2 unconformity
		Page Sandstone	0-80	
		Navajo Ss	430-510	
		Kayenta Fm	190-240	
		Wingate Ss	300-400	
TRIASSIC	Chinle Fm	Church Rock Mbr	200-400	
		Moss Back Cg Mbr	60-100	
		Temple Mountain M	0-40	Tr-3 unconformity
	Moenkopi Fm	Moody Canyon & Torrey Members	470-650	
		Sinbad Limestone M	30-50	
		Black Dragon Mbr	170-210	
PERMIAN		Black Box Dolomite	60-160	"Kaibab" in old reports
	Cutler Group	White Rim Ss	300-500	"Coconino" in old reports
		Organ Rock Shale	0-300	subsurface
		Elephant Canyon Formation	1000-1200	*Dunbarinella*; *Schwagerina*
PENNSYLVANIAN	Hermosa Group	Honaker Trail Fm	500-1000	
		Paradox Fm	1000-2500	gypsum & anhydrite & halite
		Pinkerton Trail Fm	0-500	
		Molas Fm	50	
M		Leadville Limestone	600-800	corals; endothyrid forams
D		Ouray Ls	0-100	
		Elbert Fm	150-250	
CAMB		"Lynch" Dolomite & "Maxfield" Ls	800-1000	
		Ophir Fm	150-200	
		Tintic Quartzite	160-200	
p€		Granitic & metamorphic rocks		1800 m.y. Rb-Sr

MAPS WITH TEXT–Trimble & Doelling, 1978; Williams & Hackman, 1971; CRETACEOUS–Young, 1955, 1966; McGookey, 1972; Fisher et al, 1960; Lawton, 1983; Lessard, 1973; Harris, 1980; JURASSIC–O'Sullivan, 1980b; Wright & Dickey, 1963; Derr, 1974; TRIASSIC–Stewart et al, 1972a, 1972b; Blakey, 1974; Orgill, 1971; Lupe, 1979; PERMIAN–Baars, 1962; Rascoe & Baars, 1972; PENNSYLVANIAN–Mallory, 1972; MISSISSIPPIAN–Craig, 1972; DEVONIAN–Baars, 1972; Parker & Roberts, 1966; CAMBRIAN–Lochman-Balk, 1972.

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Chart **83**

CANYONLANDS PARK AREA

			FEET	
Q		Alluvium - dune sand	0-100	
K	Morrison Fm	Brushy Basin Member	300-400	dinosaur bone
JURASSIC		Salt Wash Mbr	200-400	
		Tidwell Member	20-60	J-5 unconformity
	San Rafael Group	Wanakah Formation	0-60	
		Entrada Sandstone	220-350	ARCHES NAT'L PARK
		Dewey Bridge Mbr	20-130	
		Page Sandstone	0-100	J-2 unconformity
	Glen Cayon Group	Navajo Sandstone	250-450	rounded cliffs
		Kayenta Fm	200-260	DEAD HORSE POINT
		Wingate Sandstone	30-430	vertical cliff face; J-0 unconformity
TRIASSIC	Chinle Fm	Church Rock Member	240-310	
		Owl Rock M	70-120	
		Petrified Forest M	50-100	bentonite
		Moss Back Ss M	0-100	Tr-3 unconformity
	Moenkopi Fm	Moody Canyon M	40-120	
		Torrey Member	100-200	
		Sinbad Ls Mbr	0-20	
		Black Dragon Mbr	0-230	Tr-1 unconformity
		Hoskinnini Sandstone	0-50	
PERMIAN	Cutler Group	White Rim Ss	0-250	
		Organ Rock Fm	0-400	
		Cedar Mesa Sandstone	300-1000	Surface rock in The Needles area. Interfingers eastward with arkosic beds within the Park
		Elephant Canyon and Halgaito Fms (time equivalent)	400-1200	Thickens and becomes less limy towards Uncompahgre Uplift to the east; unconformity
PENNSYLVANIAN	Hermosa Group	Honaker Trail Formation	1000-1500	
		Paradox Formation	500-4000	Oldest rocks exposed in Canyonlands, at river level in the Gypsum Canyon area. salt & potash interbedded with black shale and anhydrite
		Pinkerton Trail Formation	200-300	
		Molas Formation	0-100	
MISS		Leadville Limestone	400-600	Pre-Paradox rocks are known from wells and from geophysical measurements
D		Ouray Limestone	100	
		Elbert Formation	300	
CAMBRIAN		Undivided Upper Cambrian dolomite, limestone, & shale	800-900	
		"Bright Angel" Shale	0-200	
		Ignacio Quartzite	100-200	
p€		Metamorphic rocks	-	

GEOLOGIC MAP - Huntoon et al, 1982; JURASSIC - Craig & Dickey, 1956; Wright & Dickey, 1978; TRIASSIC - Stewart, 1971a; Blakey, 1974; Pipiringos & O'Sullivan, 1978; Lupe, 1984; O'Sullivan & Maclachlan, 1975; PERMIAN - Baars, 1975; PENNSYLVANIAN - Welsh & Bissell, 19779; Szabo & Wengerd, 1975; SUBSURFACE - Rocky Mountain Association of Geologists Atlas, 1972. RIVER GUIDEBOOK - Baars & Molenaar, 1971.

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